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S2 Photosynthesis

2L1

Alternative Complex III from phototrophic bacteria and its electron acceptor auracyanin

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The Alternative Complex III (ACIII) is a multisubunit energy-conserving integral membrane protein complex that is proposed to be a functional replacement for bacterial cytochrome bc_1 or b_6f complex. Clues to the structure and function of this novel complex come from its relation to other bacterial enzyme families. The ACIII complex has menaquinone:electron acceptor oxidoreductase activity and contains protein subunits with multiple Fe–S centers and *c*-type hemes. ACIII is found in a diverse group of bacteria, including both phototrophic and nonphototrophic taxa. In the phototrophic *filamentous anoxygenic phototrophs*, the electron acceptor is the small blue copper protein auracyanin instead of a soluble cytochrome. Recent work on ACIII is explored with particular focus on the photosynthetic systems and potential electron transfer pathways and mechanisms. Taken together, the ACIII complexes constitute a unique system for photosynthetic electron transfer and energy conservation.

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2P1

Nanoparticles affect the function of photosystem I

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Plasmonic metal-nanostructures are an emerging tool for manipulating optical properties of fluorophores. They are used for enhancing the sensitivity of fluorescence-based assays in drug discovery and high-throughput screenings as well as in immunoassays. Even plasmon-assisted detection of biological reactions in vivo has been suggested. The fast evolving range of applications for plasmonic nanomaterials make a deeper understanding of nanostructure–protein interactions necessary.

During the last years different constructs of photosystem I (PSI) and nanoparticles were investigated in order to enhance the function of PSI [1]. Some of these constructs are also able to produce hydrogen upon illumination [2]. Here, I focus on the question, how the optical properties of PSI – a huge multi-chromophore FRET-coupled system – are modified by nearby plasmonic nanostructures [3,4]. The optical properties of these constructs are investigated by low temperature single-molecule spectroscopy. The used constructs are formed by PSI and nanoparticles/nanostructures made from gold and silver (see e.g. Fig. 1). Beside remarkable fluorescence-enhancement, significant changes of the characteristic fluorescence emission from PSI were observed. Particularly, the higher energy chlorophylls with site-energies close to the reaction center show increased deactivation via fluorescence emission, thereby, reducing the efficiency of energy transfer towards the site of charge separation (P700), and thereby, the protein function. This reduction will also affect the efficiency of PSI-nanoparticle hybrids discussed for biotechnological applications [2]. It can be supposed that altered responses can generally be expected for multi-chromophore FRET-coupled systems near to plasmonic nanostructures. The observed spectral changes are discussed in a general framework of plasmonic interaction with multi-chromophore systems [3].

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2P2

Towards the time resolved X-ray structure determination of proteins

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Structure determination of proteins and protein super complexes is as its finest with a high resolution X-ray (<2.5 Å) diffraction of macromolecular crystals. The information gathered is in detail and precision unchallenged from other methods in structural biology. In contrast to its obvious impact it is static and therefore not automatic answering questions about dynamic biological processes. With the new developed technique of serial femtosecond crystallography (SFX) [1,2,3] we are now providing the transition from molecular snapshots to molecular movies. Molecular dynamics of proteins and protein complexes can now be studied in the time domain from milliseconds to femtoseconds.

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